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Soil moisture pattern analysis in a headwater-catchment with Spatial-TDR technology

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Knowing the spatial distribution and temporal dynamics of soil moisture is important for many fields of scientific research, e.g. investigation of land slides triggering, for the optimization of irrigation or for flood forecasting. Standard TDR-techniques estimate only point information for an integral volume of soil. The Spatial-TDR-technique (STDR) here presented, however, delivers highly resolved vertically and horizontal information to a depth of 60 cm. By connecting via multiplexers up to 40 STDR sensors to a single sample, soil moisture patterns can be observed at the hillslope scale (100 m2) with a temporal resolution of 30 minutes. The geostatistical characteristics of these patterns can thus be determined for each time step. STDR encompasses three components: a sampling three-rod-TDR, an appropriate wave-guide and an algorithm to reconstruct the soil moisture profile along the wave-guide. The STDR setup is tested in the headwater catchment of the upper Wilde Weisseritz in Saxony, Germany. The STDR cluster (40 sensors) is installed in a rural hillslope close to the gauge Rehefeld, which has a mean slope angle of 9° and is dominated by cambisoils. Additional STDR clusters are planned to be installed at sites with different characteristics in regard to soil type, vegetation and topography in the same head catchment. The so obtained soil moisture data sets of the STDR network clusters deliver the statistical and geostatistical properties required for the large scale interpolation of spatial patterns. It is expected that the information extracted from the observed soil patterns will considerably improve the estimation of initial condition of current operational hydrological models to forecast flood events.